MOBILE TELECOMMUNICATION SYSTEM

Field of the invention

The present invention relates to a method and an arrangement in a mobile telecommunication system using lobes for establishing and maintaining a radio channel between a mobile station (MS) and a base station (BS).

Background of the invention

In a cellular system with a phased array antenna system narrow lobes are generated by a lobe shaping unit (LSU). These narrow lobes are directed towards mobile stations.

At call set up the direction of a mobile station within a sector is unknown. Narrow lobes cannot be established until the direction is known. The invention gives a solution on how to find both the initial direction of the mobile terminal and to detect the initial signalling. An algorithm is also described how to change from a wide lobe to a narrow lobe during call set up.

A similar problem exists when a handover is carried out between sectors or base sites.

A similar method is used for signal strength measurements.

Summary of the invention

Thus, the object of the invention is to find the initial direction of a mobile terminal, detect the initial signalling, establish and maintain a connection between the base station and the mobile station.

This object is achieved by means of a method and an arrangement according to claims 1 and 9, respectively.

Other characteristics of the invention are set out in the dependent claims.

Brief description of the drawing

A preferred embodiment of the invention will now be given below with reference to the only drawing:

Figure 1 discloses the construction of the lobe shaping system including the Direction Finding Unit according to the invention.

Detailed description of an embodiment of the invention

In the following description certain abbreviations are used throughout the text. First these abbreviations will be explained, after which the invention will be described with reference to Figure 1.

DFU	Direction Finding Unit
MS	Mobile Station
MTX	Mobile Telephone Exchange
BSC	Base Site Controller for control of LSU and DFU
BS	Base Station
TRX	Transceiver Equipment (Transmitter/Receiver Equipment)
CC	Calling Channel
TCfree	free Traffic Channel
TCho	Traffic Channel receiving handover from another channel
RSS	Radio Signal Strength
RSSI	Radio Signal Strength Indicator
LSU	Lobe Shaping Unit
SSM	Signal Strength Measurement
SR	Signal Strength Receiver or TRX used for signal strength measurements

In addition to conventional equipment as for example transmitter/receiver equipment (TRX), antenna means, control means for establishing channels, means for measuring signal strength connected to supervising means for handover decisions, the base station (BS) of the present invention also includes a Direction Finding Unit (DFU) and lobe shaping units (LSU). The RSSI-records, RSSI and fast scanning switch of figure 1 constitute the DFU. The MTX constitutes the interface to the fixed public or private network, e.g. POTS, ISDN. The MTX is considered to be the most complex part of the mobile communication system, and all final decisions regarding handover, roaming, call set up etc. emanates from the MTX. The TRX is connected to a lobe shaping unit (LSU) which in turn is connected to an antenna array. The lobe shaping unit (LSU) is arranged to form lobes with different widths and gains in arbitrary directions in both uplink and downlink by altering phase- and amplitude coefficients. The lobe shaping unit is described in detail in pending patent applications, assigned to Radio Design Innovation TJ AB, which applications are incorporated herein by reference.

Now, returning to the DFU its responsibility resides in the localisation of a mobile station (MS) as fast as possible in order to avoid that the signalling between the MTX and the MS is lost. This function is particularly required during a call set-up or in handover situations when the position of the MS initially is unknown to the BSC. The above localisation is achieved by allocating narrow antenna lobes (using LSU and an antenna array) covering the whole area inside a sector. The DFU simultaneously or preferably sequentially scans all receiving lobes. Upon detection of received signal strength in one or a multitude of the receiving lobes the

lobe with highest signal strength is selected and the BSC establishes a configured lobe in the direction of the selected lobe for communication between the MS and a TRX. It should of course be realised that the MS, before sending signals to the BS, must identify the BS. This is achieved by the BS transmitting identification signals in a wide lobe in order to inform MS, covered by said wide lobe, about its existence.

A function procedure scheme for the DFU is described below.

1. Upon receiving a CC, TCfree or TCho activation order (MTX sends order to a TRX-unit), the BSC activates the DFU. A wide lobe in the LSU is connected to the transmitter for the down link contact (paging) with the mobile station MS. The DFU is set to correct channel number and monitors the received signal in the uplink in narrow lobes.

2. The MS activates its transmitter as response to the paging to set up a MS initiated call on a new frequency after e.g. a handover order. Power starts to ramp up and before frame data is transmitted, the DFU must have identified the lobe with strongest RF-level. By scanning through the narrow lobes, the DFU will find the lobe with the strongest received signal strength. This narrow lobe is selected. The BSC sets up a path through the equipment with the selected lobe connected to the receiver.

3. During the reception of NMT-frames the DFU measures RSS and keeps a record of each lobe. The BSC reads the RSSI records from the DFU and connects continuously the best lobe to the receiver.

4. At a suitable point in the signalling scheme the BSC reads the RSSI record from the DFU and decides which lobe is best to use for transmitter part and connects the best lobe in that direction to the transmitter, i.e. the down-link wide lobe is transformed into a narrow lobe.

5. During the signalling and speech conversion, the DFU measures RSSI and the BSC continuously connects the best lobe to receiver and transmitter.

In other words, the mobile station is paged using a wide lobe in the down link, but the base station listens in the up link using narrow lobes scanned through possible directions. By narrowing the up-link lobe from e.g. 60° to 10-18°, typically 15°, the antenna gain in the base station increases a factor of approx. 4-5 (6-7 dB). This means that the output power of the mobile station may be lowered accordingly which is a great advantage because of the limited battery power available. On the other hand, the base station may transmit in the down link with

sufficient power in a wide lobe during call set-up or handover etc.,since the base station is not so sensitive with respect to the power consumption.

A similar method as above is used for signal strength measurements. The responsibility for the SSM function is to connect a SR unit (or channel unit) to the best lobe so that signal strength measurements can be performed by the SR unit, on the best lobe. The RSSI measurements are initiated from the MTX.

The SSM function uses the same hardware configuration as the DFU function.

A function scheme for the SSM function is described below.

1. Upon receiving a measurement activation order (MTX sends order to a TRX or SR unit), the BSC activates the DFU and the DFU is set to correct channel number and monitors the received signal.

2. The DFU identifies the lobe with the strongest RF-level. The BSC sets up a path through the equipment with the selected lobe connected to the SR.

3. SR performs RSSI and Φ tone measurements. In for example Nordic Mobile Telephone (NMT) quality of a call is controlled by a control signal (Φ tone) i.e. one of four tones around 4kHz. The base station transmits the Φ signal to the mobile station which returns the signal to the base station. The quality of the returned Φ signal is measured in the base station and if the quality is below a predetermined value the base station transmits an alarm to an MTX. Then, the MTX orders the base station and surrounding base stations to measure the strength of the radio signal from the mobile station. The base stations send the measurement results to the MTX, after which the MTX connects the call to the base station with highest received signal strength.

4. The DFU monitors the received signal and the BSC continuously connects the best lobe to the SR. After the RX is ready BSC disconnects SR equipment.

It would be appreciated by those of ordinary skill in the art that the present invention can be embodied in other specific forms without departing from the spirit or essential character thereof. The presently disclosed embodiments are therefore considered in all respects to be illustrative and not restrictive. The scope of the inventions indicated by the appended claims rather than the foregoing description, and all changes which come within the meaning and range of equivalence thereof are intended to be embraced therein.